General

Guideline Title

Care of the patient undergoing intracranial pressure monitoring/external ventricular drainage or lumbar drainage.

Bibliographic Source(s)

American Association of Neuroscience Nurses. Care of the patient undergoing intracranial pressure monitoring/external ventricular drainage or lumbar drainage. Glenview (IL): American Association of Neuroscience Nurses; 2011. 37 p. [164 references]

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

The levels of evidence (I-V) supporting the recommendations and levels of recommendations (1-3) are defined at the end of the "Major Recommendations" field.

Additional guidance on equipment setup, system maintenance, nursing responsibilities, and patient and family education can be found in the original guideline document.

Intracranial Pressure (ICP) Monitoring and External Ventricular Drainage Device (EVD)

Management of EVD Complications

EVD Infections

Prevention of Infection and Strict Adherence to Aseptic Technique

- Placement of any ICP monitoring device should be performed under conditions that model the operating room with maximum barrier protection. The doors should be closed, all people in the room should wear hats and masks, and the sterile field should be protected. EVD placement is frequently performed urgently, but care should be taken to maintain sterility. Contamination often occurs on the skin tract at placement (Level 2; Dasic et al., 2006). A designee should assist with catheter placement by holding the patient's head (Level 2; Leverstein-van Hall et al., 2010).
- Manipulation and accessing of the EVD drainage tubing have been shown to be sources for bacterial contamination (Level 2; Hoefnagel et al., 2008; Korinek et al., 2005; Lozier et al., 2002). The risk of CSF infection increases with the duration of the EVD (Level 2; Lozier et al., 2002; Mayhall et al., 1984; Schade et al., 2005). Therefore, access of the EVD for cerebrospinal fluid (CSF) sampling should occur

when infection is suspected (see Appendix B of the original guideline document for sample policy and procedure).

- Institutional practices vary on whether EVD tubing manipulation is a nursing or physician practice (Hoefnagel et al., 2008; Korinek et al., 2005; Muttaiyah et al., 2008). This high-risk procedure requires an institutional commitment to training and staff competency (Level 3; Criddle, 2007).
- No specific studies on cleaning of EVD access ports were found and research is needed on this topic. The best data supporting the cleaning of EVD access ports are from the vascular access device literature, but this is also limited. The Centers for Disease Control and Prevention (CDC) recommends alcohol for cleaning vascular access ports; povidine-iodine is also acceptable (Level 3; Meyer, 2009). Chlorhexidine-alcohol has been shown to be an effective antiseptic for topical skin preparation (Level 1; Darouiche et al., 2010; Hibbard, 2005). For neurosurgical procedures, it has been shown that a 3-minute cleaning with chlorhexidine-alcohol followed by two 30-second cleanings with povidine-iodine is highly effective for sterilizing the skin (Level 1; Guzel et al., 2009). The combined effect of three disinfectants—chlorhexidine, alcohol, and povidine-iodine—would have the broadest bactericidal effect but the U.S. Food and Drug Administration (FDA) has not approved chlorhexidine for purpose of cleaning access ports (Meyer, 2009).
- The drainage tubing should not be routinely changed; it should remain for the duration of the EVD (Level 3; expert panel consensus). The initial sterility of the drainage tubing must be meticulously ensured. A two-person method is ideal for priming the tubing with sterile normal saline. The second person should monitor the sterile technique and help if needed. Use a sterile barrier to assemble the drain, wear masks and hats, and wash hands before applying sterile gloves.
- If the EVD drainage tubing accidentally becomes disconnected, every effort should be made to maintain the sterility of the ventricular catheter. New sterile EVD tubing should be obtained and connected (Level 3; expert panel consensus).
- Follow strict aseptic technique when the EVD is accessed or irrigated, and use hand hygiene, mask, sterile field, and sterile gloves. Scrub the EVD access port 3 minutes with povidine-iodine or follow individual institutional policy (Level 3; Meyer, 2009; Pope, 1998) (see Appendix B of the original guideline document for sample policy and procedure).
- Maintaining CSF flow has been suggested as a method to avoid ascending infection (Level 2) (Razmkon & Bakhtazad, 2009).
- Any contamination of the collection bag can be transferred upward and is avoided by following sterile technique. When changing the collection bag, wear sterile gloves and a mask. Only change the bag when it is nearly full (Level 3; Bader, Littlejohns, & Palmer, 1995; Korinek et al., 2005; Pope, 1998). Change the bag when it is ¾ full (Level 2; Leverstein-van Hall et al., 2010; Thompson, 2000)
- The collection system should be maintained in the upright position. If for some reason the collection chamber has to be laid down (for example, there is no magnetic resonance imaging [MRI]-compatible holder), the CSF should be drained into the lower collection bag. This will decrease the transfer of any bacteria in the collection chambers to the drainage tubing (Level 3; Woodward et al., 2002).
- Hand hygiene, gloves, and a new sterile dead-end cap should be used to zero the transducer when necessary after transport. To clear air off the transducer again, wash hands before gloves then drain CSF off into sterile gauze and rezero the transducer (Level 3; expert panel consensus).
- The EVD tubing access port should be clearly labeled as EVD. It has been repeatedly documented that three-way stopcocks and other EVD ports have been accidentally mistaken for intravenous lines (Level 3; Drake & Crawford, 2005; Howell & Driver, 2008; Legal Eagle Eye Newsletter, 2007). It is recommended that manufacturers design access ports so that these types of human errors are not possible.
- EVD wound dressings and hair-removal practices vary widely. After implementing an education program to teach nursing staff a strict sterile dressing change procedure, one facility experienced a 78% decrease in infection rate (Level 3; Craighead et al., 2008).
- An occlusive dressing is placed to cover both incisions. The initial dressing is removed every 48 hours or if soiled per institutional policy. The nurse removes this initial dressing with sterile gloves and also wears a mask. If the hair grows out, the nurse clips it again so that the gauze dressing adheres. The site is inspected for CSF leaks or infection. The nurse then removes the first pair of gloves. Hand hygiene is then performed for a second time before applying a new, second set of sterile gloves. A new sterile gauze dressing is applied to the site, and benzoin is used to hold the tape. The dressing is tight and occlusive. (Level 3; Craighead et al., 2008).
- For EVD-associated infection rates greater than 10%, it is recommended the institution should investigate its practices and EVD protocols (Level 3; Lozier et al., 2002).
- CSF leaks represent a site for bacterial en-trance and, when discovered, are important to report (van de Beek, Drake, & Tunkel, 2010).
    - When the EVD is removed, the site should be monitored for a CSF leak. An additional suture may be needed to close the skin incision. There is a high risk for infection with CSF leak after EVD removal, so careful monitoring post removal is warranted (Level 2; Korinek et al., 2005).
    - No IV tubing or cords that could cause tension should be allowed on top of the EVD tubing.
    - If the EVD is accidentally removed, occlusive pressure should be held at the site.

Clinical Signs of Bacterial Ventriculitis and Meningitis in EVD-Associated Infection

- New or increasing headache, nuchal rigidity, and decreased level of consciousness or cranial nerve signs are reasons to send CSF for infection surveillance (Level 2; Arabi et al., 2005; Frontera et al., 2008; Hoefnagel et al., 2008; Schade et al., 2006; van de Beek, 2004).
- Persistent and recurrent fever indicates the need to investigate for CSF infection. Positive CSF culture is highly correlated with fever (Level

2; Chang et al., 2008; Weisfelt et al., 2007; Schade et al., 2006).

CSF Analysis

- CSF processing must be completed quickly to ensure accurate results because CSF is hypotonic. Cell counts decrease by 32% after 1 hour and 50% after 2 hours, and bacteria may not survive long periods in collection tubes (Level 3; Gray & Fedorko, 1992; Johnson & Sexton, 2009). For this reason, CSF is rapidly hand delivered to the laboratory in some institutions. It is imperative that CSF obtained by lumbar puncture is not lost because the patient would require another lumbar puncture to obtain additional CSF.
- After receiving the report of CSF analysis from the laboratory, notify the physician or advanced practice nurse immediately.

Treatment of Infection

- The EVD should remain closed, usually for 1 hour, post instillation of antibiotics (Level 3; van de Beek, Drake, & Tunkel, 2010; Ziai & Lewin, 2009).
- Monitor patients receiving intraventricular antibiotic therapy for signs of neurotoxicity: meningeal irritation, delirium, confusion, focal to general seizures, and hearing loss (Level 3; James & Bradley, 2008; Ziai & Lewin, 2009).
- Infected EVD catheters should be removed, but there is no consensus on the removal timing (Level 3; James & Bradley, 2008; van de Beek, Drake, & Tunkel, 2010; Ziai & Lewin, 2009). Unstable patient conditions may make catheter removal difficult. In multidrug-resistant acinetobacter meningitis there has been very high mortality when the EVD was not removed (Level 2; Rodriguez Guardado et al., 2008).

Noninfectious Complication of EVD

Aneurysmal Rebleeding and Hemispheric Shifts from Reduction in ICP

- Monitor ICP drainage and ICP carefully in unsecured ruptured subarachnoid hemorrhage patients and maintain a low threshold to clamp the EVD to prevent CSF overdrainage (Level 3; Fountas et al., 2006).
- Rapid recognition of aneurysmal rebleeding can be lifesaving. Immediately notify the neurosurgical or neurointensivist team if bright red blood suddenly appears in the EVD tubing and drip chamber. There should be associated vital sign changes: elevated ICP and blood pressure. Discuss measures to control blood pressure elevations with the medical team (Level 3; Rose & Mayer, 2004), which may include:
  - Continuous nicardipine infusion
  - Intravenous labetalol as needed
- Care should also be taken to avoid CSF overdrainage in patients with unilateral mass lesions to avoid potential hemispheric shifts. (Level 2; Frank, 1995) (Level 3; Adams et al., 2007).

CSF Overdrainage

- The amount of CSF drainage can affect ICP (Level 2; Kerr et al., 2001). Raising the pressure level of the graduated burette above the zero reference level may create expected pressures within the brain.
  - A 20-cm pressure level above the zero reference level will usually result in an ICP of 20 mmHg. This pressure can have a "tamponade" effect on unsecured ruptured subarachnoid aneurysm (Level 3; Fountas et al., 2006). This can also be a method for gradual weaning from the EVD (Level 2; Klopfenstein et al., 2004).
  - A 10-cm pressure level above the zero reference level will usually result in normal pressures.
  - A zero pressure level is used for maximal pressure unloading and the pressure treated from the CSF would be zero. In this case, there are usually other reasons the patience has higher pressures, such as cerebral edema.
- Maintain the EVD drip chamber at the prescribed zero reference and pressure levels (Level 3; Freiman & Spiegelberg, 2008; Woodward et al., 2002).
  - Inform the patient and his or her family that changing the bed position is to be performed only with assistance. Raising the level of the bed with an EVD at a fixed zero reference and pressure levels can result in a large increase in CSF drainage.
  - Ensure that the zero reference and pressure levels are maintained.
  - Educate all members of the medical team about the risks of changes in the height of the bed (Level 3; Muraskin, Roy, & Patrozza, 2007).
- Clamp the EVD any time there is a patient response or procedure that may cause CSF overdrainage (Level 3; Woodward et al., 2002). Unclamp and allow CSF drainage when the stimulation has stopped and the patient is settled.
  - Clamp EVD for coughing, vomiting, suctioning, or repositioning.
  - Observe patient responses to provide care, and plan according to these responses.
  - Sedation may be given prior to nursing procedures.
  - Clamp the EVD prior to the disturbances that occur during patient transport. Un-clamp when the nursing procedures are completed.

Hemorrhage and Misplacement Complications of EVD Placement

- The patient may need sedation, but this will vary greatly depending upon the medical condition of the patient: prior intubation, obtundation, or alert and awake. The nurse must monitor and document the patient's respiratory status and vital signs during the entire procedure and cannot leave the bedside. Other nurses will be required to assist if materials or medications are needed that are not present at the bedside.
- Assess CSF flow and ICP waveform (Level 2; Kakarla et al., 2008).
- Prepare to assist with placement of an alternative ICP monitor if multiple freehand passes are needed (Level 3; Huyette et al., 2008).
- Postprocedure head CT scans are not routinely completed in all institutions, but patients often require a head CT for other reasons within 24–48 hours. Ensure that the head CT is completed in a timely fashion.

Lumbar Drainage Devices (LDDs)

Equipment Setup

Procedure for Priming the LDD Tubing

Set the zero reference level with each patient position change, particularly when the head of the bed has been raised or lowered, during patient transport, or if the patient has been out of bed or is returned to bed (Level 3; expert panel consensus).

Nursing Responsibilities Postplacement

Patient Assessment

1. The patient should be assessed every hour in the intensive care unit (ICU) setting and every 1–2 hours in the intermediate care or floor setting (Level 3; expert panel consensus). Changes from the baseline neurological assessment include, but are not limited to, decreased level of consciousness, focal deficit, pupillary changes, vision, headache, and signs of meningeal irritation (e.g., photophobia, nuchal rigidity, headache, irritability). More frequent assessment may be indicated by patient condition or type of drainage regulation used. The physician, advanced practice nurse, or other qualified healthcare provider should be notified immediately of all neurological changes.
2. The patient should be assessed every 1–2 hours (Q 1 hour for intensive care unit setting; Q 2 hours for floor setting) for signs and symptoms of infection, including presence of elevated temperature and signs of infection or leaking at the insertion site (Level 2; Clevenger, 1990; Governale et al., 2008; Hoekema, Schmidt, & Ross, 2007).
3. The amount, clarity, and color of CSF drainage should be assessed and recorded every 1–2 hours (1 hour for ICU setting; 2 hours for floor setting) as ordered by the physician, advanced practice nurse, or other qualified healthcare provider. More frequent checks may be required while ensuring the level of the drain is yielding appropriate amounts of CSF drainage for volume-regulated drainage. During this time, the level of the drain and security of the drainage system to maintain the appropriate position should also be assessed (Level 3; expert panel consensus).

Management of LDD Complications

Bacterial Colonization and Infection

Remove the drain and provide antibiotic treatment (Level 3; Governale et al., 2008).

Meningeal Irritation

Monitor for nuchal rigidity, photophobia, and turbid or purulent CSF. The physician should be notified immediately of these symptoms (Level 3; Littlejohns, 2009).

Nerve Root Irritation

Prompt catheter removal by the healthcare provider is recommended for limb weakness (Level 3; Ganjoo et al., 2009).

Definitions:

Levels of Evidence

Class I: Randomized controlled trial without significant limitations or meta-analysis

Class II: Randomized controlled trial with important limitations (e.g., methodological flaws, inconsistent results), observational study (e.g., cohort, case control)

Class III: Qualitative study, case study, or series

Class IV: Evidence from reports of expert committees and/or expert opinion of the guideline panel, standards of care, and clinical protocols that have been identified

Levels of Recommendations

Level 1: Recommendations are supported by class I evidence.

Level 2: Recommendations are supported by class II evidence.

Level 3: Recommendations are supported by class III and class IV evidence.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Conditions requiring intracranial pressure monitoring/extraventricular ventricular or lumbar drainage

Guideline Category

Counseling

Evaluation

Management

Prevention

Treatment

Clinical Specialty

Critical Care

Infectious Diseases

Neurological Surgery

Neurology

Nursing

Surgery

Intended Users

Advanced Practice Nurses

Hospitals

Nurses

Guideline Objective(s)

To assist registered nurses (RNs), patient care units, and institutions in providing safe and effective care to patients undergoing intracranial pressure (ICP) monitoring via an external ventricular drainage device (EVD) or subarachnoid drainage of cerebrospinal fluid with a lumbar drainage device (LDD)

Target Population

Patients undergoing intracranial pressure (ICP) monitoring via an external ventricular drainage device (EVD) or subarachnoid drainage of cerebrospinal fluid with a lumbar drainage device (LDD)

Interventions and Practices Considered

Management/Treatment

1. Equipment setup, including priming, zeroing, and calibrating devices
2. Obtaining an intracranial pressure tracing
3. Draining cerebrospinal fluid
4. Catheter insertion, including patient preparation
5. System maintenance and assessment
6. Management of complications, including infection
7. Device removal

Counseling/Prevention

1. Reporting CSF leaks
2. Notification of CSF analysis results
3. Patient/family education

Major Outcomes Considered

- Incidence of infection
- Incidence of noninfectious complications
- Mortality

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

In development of this guideline, nurse experts reviewed the published literature from 2000 to December 2010 using PubMed/Medline, EMBASE, and Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the search included the following terms: intracranial pressure monitoring device, intracranial pressure waveform, external ventricular drain, lumbar drain, indwelling catheters, drainage, cerebrospinal fluid, ventriculostomy, and nursing. Monographs and textbooks were also consulted. Studies not written in English were excluded from further evaluation.

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Expert Consensus

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Levels of Evidence

Class I: Randomized controlled trial without significant limitations or meta-analysis

Class II: Randomized controlled trial with important limitations (e.g., methodological flaws or inconsistent results), observational studies (e.g., cohort or case control)

Class III: Qualitative studies, case study, or series

Class IV: Evidence from reports of expert committees and expert opinion of the guideline panel, standards of care, and clinical protocols

Methods Used to Analyze the Evidence

Systematic Review

Description of the Methods Used to Analyze the Evidence

Data quality was evaluated based on the evaluation of available evidence and expert panel consensus.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Recommendations for practice were established based on the evaluation of available evidence and expert panel consensus.

Rating Scheme for the Strength of the Recommendations

Levels of Recommendation

Level 1: Recommendations are supported by class I evidence.

Level 2: Recommendations are supported by class II evidence.

Level 3: Recommendations are supported by class III and IV evidence.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Peer Review

Description of Method of Guideline Validation

The guideline underwent peer review by a panel of reviewers listed in the guideline document.

Evidence Supporting the Recommendations

References Supporting the Recommendations

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Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for selected recommendations (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Safe and effective care of patients undergoing intracranial pressure monitoring (ICP) monitoring via an external ventricular drainage device (EVD) or subarachnoid drainage of cerebrospinal fluid with a lumbar drainage device (LDD)

Potential Harms

Not stated

Contraindications

Contraindications

It is contraindicated to place ventricular catheter in nondominant hemisphere.

The relative contraindications to a lumbar drainage device (LDD) are:

- Coagulopathy, active bleeding, or severe thrombocytopenia
- Brain abscess
- History of prior lumbar spine surgery
- History of prior lumbar vertebral fracture

The absolute contraindications to a LDD are:

- Increased intracranial pressure (ICP) (excludes documented pseudo-tumor cerebri patients)
- Unequal pressures between the supratentorial and infratentorial compartments as evidence by the following head CT findings:
  - Midline shift
  - Loss of suprachiasmatic and basilar cisterns
  - Posterior fossa mass
  - Loss of the superior cerebellar cistern
  - Loss of the quadrigeminal plate cistern
- Infected skin over the needle entry site
- Spinal epidural abscess
- Intracranial mass
- Obstructive noncommunicating hydrocephalus
- Spinal arteriovenous malformation

Qualifying Statements

Qualifying Statements

- The authors, editors, and publisher of this document neither represent nor guarantee that the practices described herein will, if followed, ensure safe and effective patient care. The authors, editors, and publisher further assume no liability or responsibility in connection with any information or recommendations contained in this document. These recommendations reflect the American Association of Neuroscience Nurses' judgment regarding the state of general knowledge and practice in this field as of the date of publication and are subject to change based on the availability of new scientific information.
- This guideline is not intended to replace formal learning, but rather to augment the knowledge base of clinicians and provide a readily available reference tool.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Resources

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Living with Illness

IOM Domain

Effectiveness

Patient-centeredness

Safety

Identifying Information and Availability

Bibliographic Source(s)

American Association of Neuroscience Nurses. Care of the patient undergoing intracranial pressure monitoring/external ventricular drainage or lumbar drainage. Glenview (IL): American Association of Neuroscience Nurses; 2011. 37 p. [164 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

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American Association of Neuroscience Nurses - Professional Association

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Guideline Committee

Not stated

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Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the American Association of Neuroscience Nurses Web site .

Availability of Companion Documents

The following is available:

- Putting guidelines into practice: ICP/EVD/LD. CPG Web cast. Available from the American Association of Neuroscience Nurses Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on January 23, 2012. The information was verified by the guideline developer on February 2, 2012. This summary was updated by ECRI Institute on March 6, 2014 following the U.S. Food and Drug Administration advisory on Over-the-Counter Topical Antiseptic Products.

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